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Inner-shell Photodetachment of Na^- H. -L. ZHOU, Georgia State University, S. T. MANSON, Georgia State University, A. HIBBERT, Queen's University of Belfast, T. W. GORCZYCA, Western Michigan University — Calculations of the photodetachment of a 2p core electron in the Na^- ion over the photon energy range 30-41 eV have been performed using R-matrix theory with a perturbative method in the asymptotic region. Our results show a very strong Feshbach resonance in the Na $1s^22s^22p^52s^2(^2P)$ channel at about 34 eV, just below the $1s^22s^22p^53s3p(^2D)$ threshold, the $1s^22s^22p^53s3p^2(^1P)$ resonance. Since 3s and 3p orbitals are about the same "size", they have a significant attractive exchange interaction; this attraction pulls the resonance below the $1s^22s^22p^53s3p(^2D)$ threshold, making it a Feshbach resonance. The Auger decay $1s^22s^22p^53s^2 \rightarrow 1s^22s^22p^6\ (Na^+) + e$ leads to the production of Na^+. Therefore, we expect experiment to find this resonance around 34 eV. But recent experiment explored in this region and found nothing [1]. We are puzzled by this discrepancy. Another resonance in our calculation is located at 36.318 eV, just below the $1s^22s^22p^53s4s\ (^2P^o)$ threshold. This resonance is confirmed by experiment [1] which is found at 36.213 eV and assigned as a $1s^22s^22p^5$ 3s 4s *nl* resonance. The situation remains under theoretical scrutiny Work was supported by DOE, NASA and NSF. [1] A. M. Covinton *et al.*, J. Phys. B **34**, L735 (2001) and D. J. Pegg, private communication (2005).

H. -L. Zhou
Georgia State University

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